



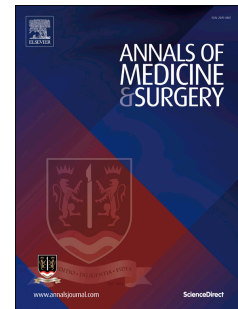
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Practice, benefits, and impact of personal protective equipment (PPE) during COVID-19 era: Envisioning the UN sustainable development goals (SDGs) through the lens of clean water sanitation, life below water, and life on land in Fiji: Research article

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Practice, benefits, and impact of personal protective equipment (PPE) during COVID-19 era: Envisioning the UN Sustainable Development Goals (SDGs) through the lens of clean water sanitation, life below water, and life on land in Fiji: Research Article

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Practice, benefits, and impact of personal protective equipment (PPE) during COVID-19 era: Envisioning the UN Sustainable Development Goals (SDGs) through the lens of clean water sanitation, life below water, and life on land in Fiji: Research Article

Abstract

Background: The outbreak of coronavirus disease (COVID-19) highlights the global health emergency. To limit the rate of COVID-19 transmission to health care workers, adequate personal protective equipment's (PPE's) are required. Emerging reports indicate that the widespread usage of PPE during the COVID-19 outbreak has exacerbated plastic contamination in the ocean.

Purpose: This paper attempts to understand the influence of practice, benefits, and impact of personal protective equipment (PPE) during the COVID-19 crisis on clean water sanitation, life below water, and life on land (SDGs 6, 14, and 15 respectively) in Fiji and assess the effectiveness of measurements taken to deal with this crisis. Fiji is a small Pacific Island Country (PIC) and the global crisis of COVID-19 entered the Fijian border on 19th, March 2020. Sadly, the second wave of COVID-19 was reported on 18th, April 2021, which began at a managed quarantine facility after contact between a couple returning from India to Fiji and a soldier. Since then the number of cases have been increasing daily and posing a risk to the public.

Materials and method: A personal observations were made to collect the PPE pollution on the streets, near roads, car parks, markets, and towns.

Results: The widespread PPE pollution was noticed, the common PPE found in the Vesivesi road of Suva, Fiji was facemask (61.36%) and hand gloves (38.64%), as it is mostly used by the general public, police offices, municipal waste management, shopping malls works, and medical care workers. Face shield littering was limited due to fewer users.

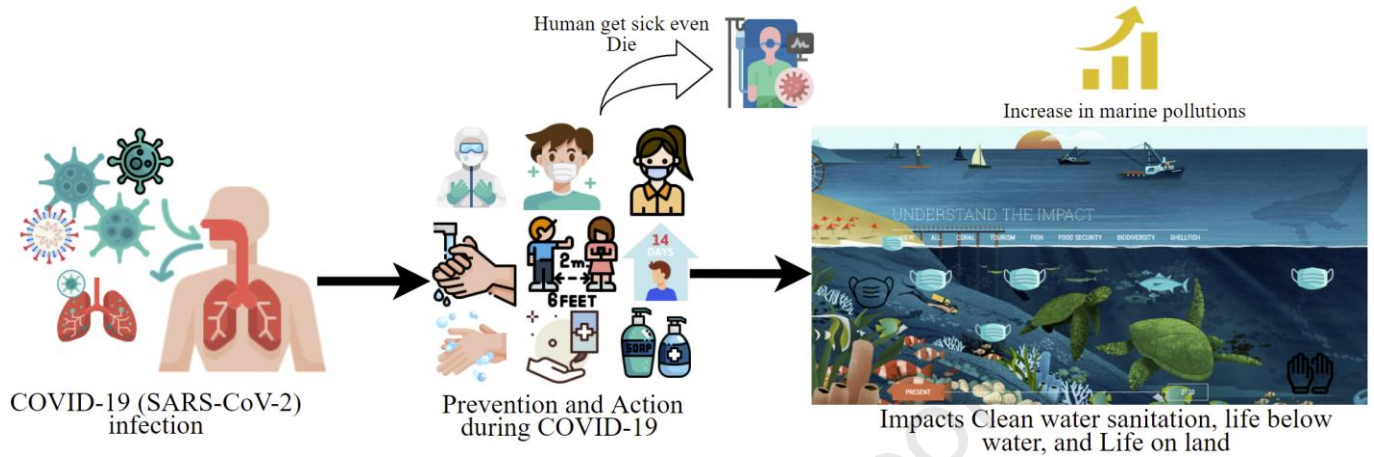
Conclusions: In response to the COVID-19 pandemic, this study stresses a great concern on enabling SDGs 6, 14, and 15 and how the use of PPEs during COVID-19 has impacted the natural environment. It is critical to remember that managing PPE waste during a contagious pandemic should be treated as an emergency and handled quickly.

Index Terms — COVID-19, Personal protective equipment (PPE's), SDGs, microplastic, single-use-plastics, and pollution.

Highlights:

- The single use of PPEs has impacted the environmental sustainability.
- COVID-19 precautionary measures are impacting water resource.
- COVID-19 precautionary measures are affecting marine life and animals.
- To be sustainable, the policy-industry-research link must be straightened.

Graphical Abstract.



1.0 Introduction

The novel, threatening, and deadly coronavirus (COVID-19) crisis has potentially confirmed that the use of personal protective equipment (PPE) and health measures are very important [1-2]. By the end of 2019, a new deadly virus called SARS-CoV-2 was discovered in Wuhan City, Hubei Province, China [3-6]. Today a significant amount of research has been conducted in reasoning the effect of this virus on social wellbeing [7-12]. As it is well known that this virus transmits from one person to another, however, to control the spread of this virus simple steps are given in Fig. 1 [13].

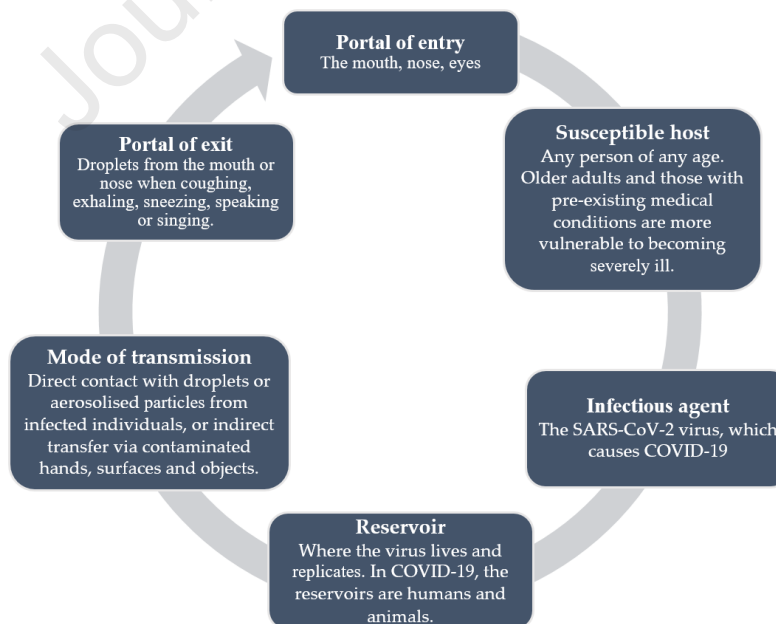


Fig. 1: The COVID-19 infection chain.

With the ever-increasing concern about this virus, the general public followed all safety precautions which were directed by World Health Organization (WHO) [14-15]. The common method used to control the spread of the COVID-19 virus is through the rational use of PPE in health care and community settings, as well as during the handling of cargo. In this context, PPE includes gloves, surgical masks, goggles or a face shield, and gowns, as well as for specific procedures, respirators (i.e. N95 or FFP2 standard or equivalent) and aprons [16-18]. This reduces the risk of health workers transmitting the SARS-CoV-2 virus to others, or becoming infected with the SARS-CoV-2 virus themselves.

Furthermore, in order to prevent the transmission of the COVID-19 virus, health professionals are generally urged not to reuse their PPE, signifying that lots of plastic medical waste are generated daily. To restrict the community spread of COVID-19, WHO has suggested following individual precautions such as wearing proper PPE (i.e., hand gloves, face masks, and face shields), social distancing, frequent handwashing, and limiting interpersonal interaction to outside situations, and closure of educational institutions in most countries [2,6]. Besides, practically every country has advocated using facemasks to limit human-to-human transmission and protect the most sensitive and at-risk individuals. As a result, millions of facemasks have been created, used, and destroyed every day in accordance with this guideline and strict directives.

Largely, the majority of single-use PPE used by healthcare professionals and the public at large is thrown daily. The commonly used materials is given in Fig. 2. In response to the COVID-19 pandemic and waste generated by the use of PPE in areas of medical facilities, parking lots, beaches, road, shopping carts, and gutters. Apart from the health concerns raised by the COVID-19 crisis, this pandemic has exacerbated the problem of microplastic issues by boosting consumer demand for single-use products and materials for safety purposes.

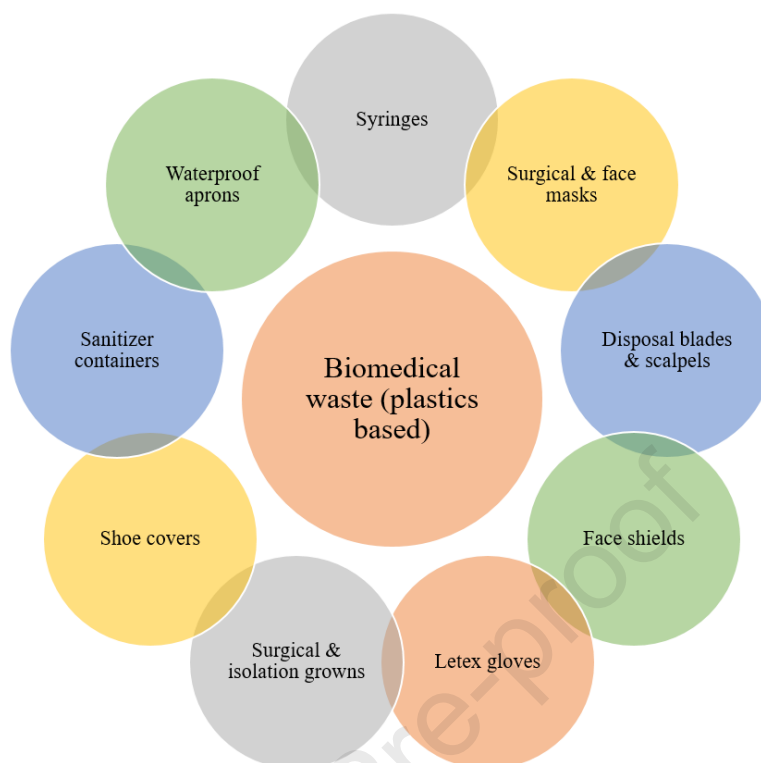


Fig. 2 Types of plastic based biomedical wastes originated during COVID-19 pandemic

Notably, the footprint of COVID-19 and all the risk associated with it was experienced in small Island pacific countries such as Fiji [19-20]. Fiji is one of the developing states, consisting of over 300 small islands, and has a population of almost 902,004 as of May 11, 2021, based on Worldometer elaboration of the latest United Nations data [21]. The two major islands are Viti Levu and Vanua Levu. Fiji is a Pacific Island Country (PIC) and the spread of this virus was first reported on 19th, March, 2020. Currently, the second wave of COVID-19 is affecting the Fijian citizens [20, 22-23]. The widespread of this virus has led to many lockdowns and isolations.

To overcome the spread of this virus, it was enforced to use the proper PPE which is used to regulate the number of COVID-19 cases [1-2,9, 13,16-17,]. Health-care staff must take additional measures to protect themselves and avoid transmission in the workplace. PPE should be used properly by health care staff caring for COVID-19 patients, which includes choosing suitable PPE and being trained on how to put it on, its removal, and disposal [16-17]. On the other hand, the use of PPE has posed a greater risk to the environment in which suitable disposal process is not applied for used PPEs. The ongoing COVID-19 pandemic has largely utilized single-use plastics globally, hence this has led to take-make-use-throw business. To cope up with the large production, use, and disposal of PPEs, this event presented new challenges to traditional waste management

systems. Nonetheless, improper disposal of PPEs has raised a serious concern for the marine environment. It was evident that a huge amount of PPEs were found in the sea, river, and picnic habitation and this will be continued in coming years as daily more usage of such materials is noticed [24]. Apart from the health concerns, this pandemic has contributed to Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) issues. Section 2 gives an overview of the PESTLE analysis.

In 2017, The Fijian Government launched its 5-Year & 20-Year National Development Plan (NDP) with the vision of transforming Fiji with sustainability and combat climate change as given in Fig. 3 [25]. In addition, the 2030 Agenda, when combined with the Paris Agreement, is revolutionary and has a high development objective. Among 17 SDGs, clean water sanitation, life below water, and life on land are the three SDGs, 6, 14, and 15, respectively, and they set a platform to combat the issue raised with COVID-19 (i.e. environmental pollution) [25]. On the same note, the geographical location of Fiji is such, where access to ocean and river is quite oblivious and due to improper disposal of PPE, a serious concern is raised. The past and current wave of COVID-19 has made noticeable environmental pollution around beaches, sea beds, near roads, bus stations, car parks, markets, towns, and cities, as given in Fig. 3. All these finally end up in the ocean creating a serious problem with marine life, due to micro-plastic present in PPEs.

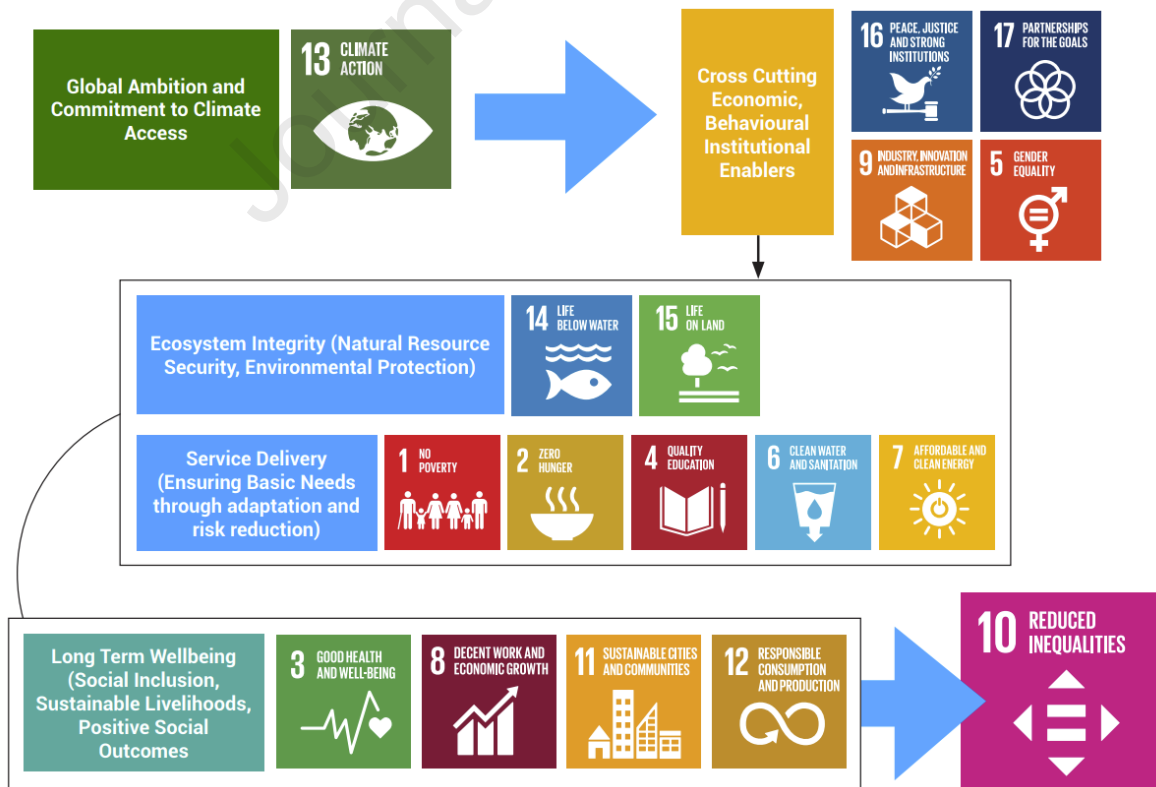


Fig. 3: Depicts the ACT which Fiji government has put in place with National Development Plan (NDP) and UN SDGs.

Here, in light of the act which government of Fiji has put in place, the following areas needs to be addressed; combat for climate change and promote sustainability. Hence, this research suggests the need of PPEs, disposal methods, and its impact on the natural environment. The need for this research is to fill current knowledge gaps regarding COVID-19-associated by PPE pollution and lay groundwork for better waste management systems.

2.0 Background

Studies have revealed that the most serious drawback of the COVID-19 pandemic is the negligence on environmental issues, which has resulted in global crises due to higher micro-plastic pollution. WHO has confirmed that standard PPEs are single-use, and after use, it becomes a harmful medical waste [16-17]. Yu et al. [26], clarified that COVID-19 has generated substantial amounts of harmful waste globally while Feng et al. [27], showed that China, Japan, South Korea, and other countries have given instructions to wear masks in public. Considering this, there is an immeasurable single-use of plastic materials, so it is essential to take measures in preventing the spread of the infection by the use of proper PPEs and its appropriate disposal method. Due to the state of emergency, the general public, medical officers, police, and security officers are required to use PPEs, particularly face masks, gloves, face shields, and use proper disposing mechanisms. Besides, a lot of environmental issues have been raised during this period, the used PPEs are found stranded on the beaches, coastlines, rivers, and littering cities which directly impact three different SDGs. Figure 3 illustrates the implication of PPEs on clean water sanitation (SDG6), life below water (SDG14), and Life on land (SDG15).

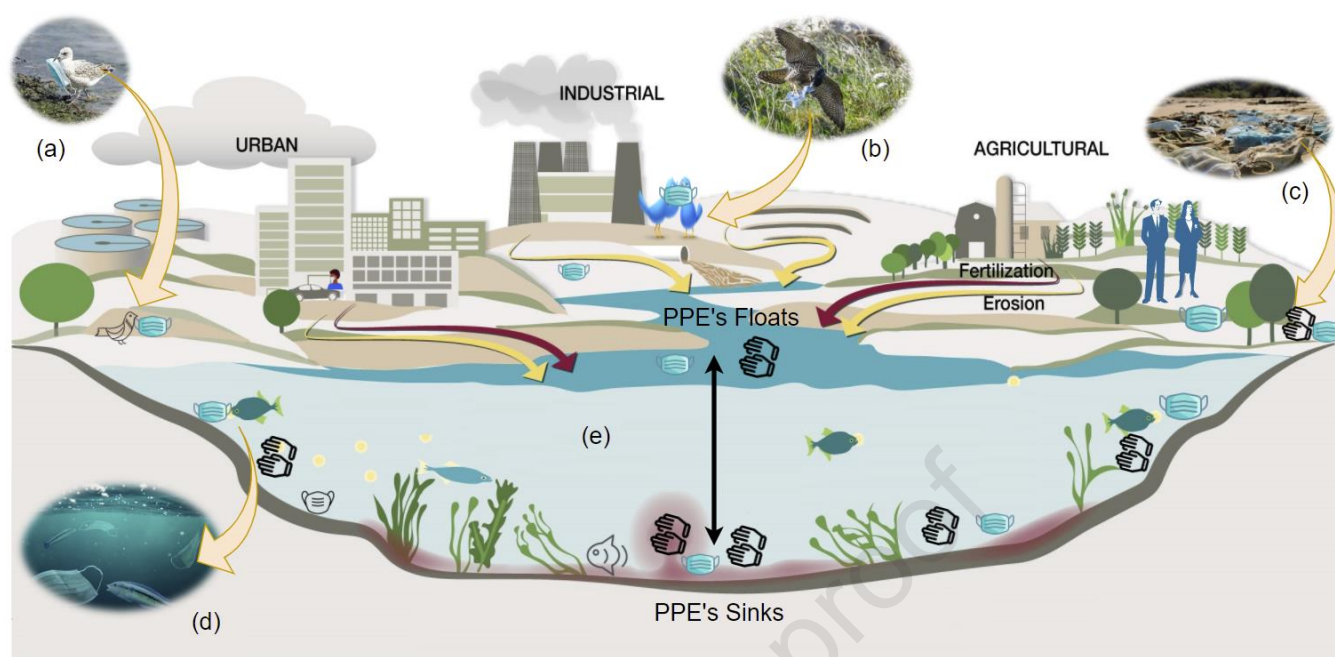


Fig.4: A graphical representation of PPE's pollution caused due to COVID-19.

The Fig. 4 depicts, land pollution, air-pollution, and water pollution. Figure 4 (a) and (b) conveys that the improperly disposed PPE materials are picked by the birds or animals which can promote the spread of virus to animals and also it becomes a medium to be transferred into the water streams and seas. Figure 4 (c) shows human negligence on the disposal of the PPEs used by the medical staff, general public, business communities and waste management departments which can lead to a polluted environment and a hindrance to health safety, Figure 4 (d) and (e) shows a sad reality that the disposable PPEs end up in our marine ecosystem posing a danger to the marine lives and an unsafe water body. Nonwoven materials (e.g., spunbond and meltblown spunbond) are used to make most disposable face masks, with polypropylene and polyethylene. Hand gloves are generally made of plastic materials with low-density polyethylene, nitrile, latex, and vinyl, mostly it has high chemical and mechanical resistance, resulting in high persistence in the atmosphere following dispersion. Hence, it is clear that PPE poses a lot of environmental challenge when it is not properly disposed.

The above representation reveals that poor PPEs waste management in the COVID-19 era has significantly impacted marine life, freshwater, and life on land. Table 1 summaries the steps involved in handling the PPEs. According to Fadare and Okoffo, some PPEs have composite materials with synthetic non-degradable polymers which make them to either float or sink depending on their characteristics [28]. De-la-Torre et al. [29], shared an observation on types of plastic pollutants. It was evident that some PPEs can persist in the ecosystem for extended periods, being equally susceptible to surface open ocean,

while others may appear submerged in the sediments, eventually becoming part of the geological record. Studies have indicated that seawater has a massive amount of micro-plastic [30]. Apart from other marines, micro-plastic pollution COVID-19 era has greatly impacted the clean water sources, marine life, and animals. All this augment is true for Fiji as well, improper disposal of PPEs has significantly impacted environment.

Table 1: Different steps involved in handling the PPEs.

Type	Protection	Appropriate for	Use guidelines	Reuse	Fabrication
Homemade (cloth mask)	Huge droplets from coughs or sneezes can be protected.	Members of the society who abide by the laws.	People who wear must maintain physical distance, wash their hands often, and avoid touching their ears.	If properly washed, it can be used again.	It is cheap and easy to make with breathable fabrics like cotton or cotton blends.
Clinical mask	Fluid-resistant and capable of filtering small particles.	For front-line health care providers	Jobs in the medical field must adhere to the rules of the organization.	Health workers should follow institutional protocol.	Fabrication standards must be followed when using medical-grade polypropylene.
N95 Respirator	Filters 95% of very small particles when tightly fitted.	For front-line health care providers. More masks are required for healthcare professionals so community use is discouraged.	To be completely accurate, skilled fit-testing is needed.	Following CDC guidelines for long-term use or reuse is needed.	Specialized materials and processes were used to create this product.

2.1 Overview of COVID-19 Pandemic in Fiji

The first case of COVID-19 was reported on the 19th of March, 2020 [20]. Alongside this, between March 20th and April 18th, a total of 54 new cases were confirmed of which, 37 cases either were related to international travel or epidemiologically linked to international travel, while the remaining 18 cases were thought to be spread across the population. Throughout this phase, 53 people (cases) recovered, but there were two deaths in the country due to COVID-19 [20]. The happiest period for Fiji was from 19th April to 5th July when there was no positive case recorded. The cases which occurred after 6th July were associated with international travel while undergoing a mandatory 14 days quarantine period in Nadi at the international border quarantine facilities. This was considered the first wave of COVID-19 for the country.

Sadly, due to a breach at the international quarantine facility, Fiji was hit by the second wave of the COVID-19 pandemic. Now, the country again has locally transmitted cases, border quarantine cases as well as community transmitted cases. At present, the country has 1542 active cases in isolation. Looking at the current (April, 2021) outbreak a total of 2020 cases has been reported and overall 2090 cases since the 1st outbreak which started in March, 2020 [23]. On the bright side, a total of 532 individuals have recovered from COVID-19. With this, the country recorded its seventh death on June 20th, 2021 of which 5 deaths are from current outbreak and remaining 2 deaths from previous outbreak. Also, 8 COVID-19 positive patients have died from pre-existing non-COVID-19 related illnesses and 1 death is under investigation, as of 21st June, 2021. In addition, a total of 172, 863 COVID-19 laboratory tests have been conducted to date [31].

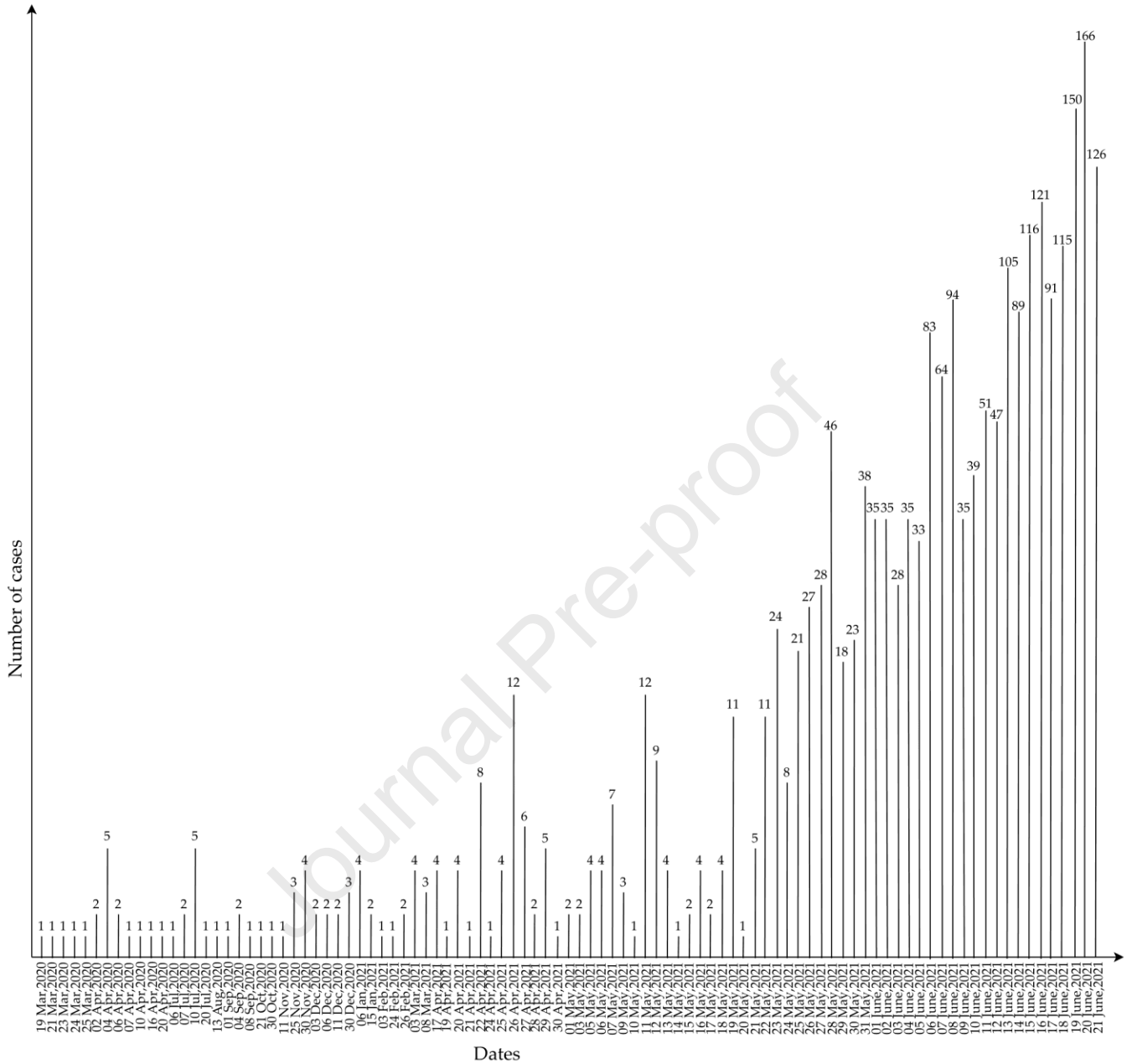


Fig. 5: Total positive cases of COVID-19 in Fiji.

Figure 5 illustrate the number of COVID-19 cases the country has encountered per day. The second wave of the virus is relatively much higher compare to the first wave in 2020. One of the main contributing factor for the increasing number of cases is negligence of COVID-19 protocols. The double mutation variant known as B1617 which was discovered in India, has also been found in the country following recent testing [31]. This is caused a lot of fear in the citizens as well as the thought of

lockdown. Due to such reasons people have disregarded the COVID-19 protocols such is social distancing, use of face masks, sanitizers, etc. Sadly, there was four death case reported during COVID-19 pandemic in Fiji, given in Fig. 6.



Fig. 6: Number of deaths caused by COVID-19 in Fiji.

2.2. Categories of PPE used in Fiji

Facemasks and hand gloves are two of the most widely worn personal protective equipment (PPE) in Fiji, but face shields are still used in some convenience stores. General public wear face mask when they move out, commonly homemade cloth masks are used. The common type of PPEs used and the materials utilized in its production are given in Fig. 7 and Table 2.

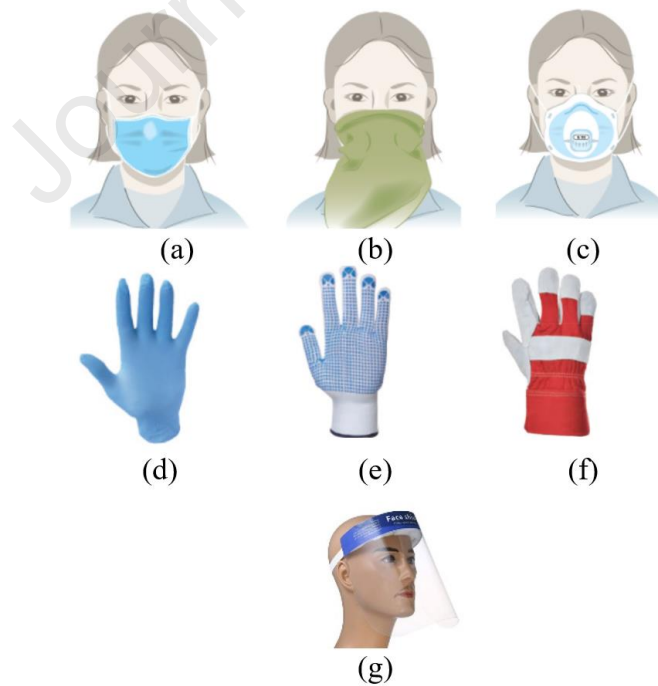


Fig 7: Different PPEs used in Fiji.

Table 2: Different types of PPEs used in Fiji during COVID-19 pandemic.

Common PPE	Different types of the PPE	Fig. Reference
Facemask	<i>Surgical mask</i> Material used – non-woven fabric/ polypropylene Benefits – One way protection. Captures particles or droplets from wearer only.	Fig. 7(a)
	<i>Homemade (DIY)</i> Material used – cotton, chiffon, and silk. Benefits – Could help stem rocketing infection rates	Fig. 7(b)
	<i>N95</i> Material used – synthetic plastic fibers usually polypropylene. Benefits – Two way protection. Filters air entering/exiting the wearer. – Filters at least 95% of airborne particles.	Fig. 7(c)
Hand gloves	<i>Disposable gloves</i> Material used – nitrile, latex, or vinyl Benefits – protection against mild irritants.	Fig. 7(d)
	<i>Fabric gloves</i> Material used – cotton or fabric Benefits – insulate from heat and cold. – Enhance grip for better handling.	Fig. 7(e)
	<i>Leather gloves</i> Material used – leather Benefits – protection from rough abrasive surfaces.	Fig. 7(f)
Face shield	Material used – polycarbonate and polyester Benefits – Protects eyes. – Prevent individuals from touching their faces constantly. – Complements masks.	Fig. 7(g)

In general, to overcome the serious issue of marine pollution caused by inappropriate PPEs disposal, it can be suggested that, low-density polymers should be used as artificial substrates for rafting non-native or invasive organisms. Another great and important research could provide a better solution if organic materials can be used for face masks.

3.0. Practice, Benefits, and Impact of PPE in the post-COVID-19 Pandemic

Earlier it has been mentioned that facemasks, hand gloves, and face shields are among the most popular PPEs used in Fiji. The major benefit of wearing PPE is that it reduces the risk of spreading COVID-19 virus. This will be achieved when the transfer rate will decrease, because the virus will be contained within the PPE. Thus, there will be a lower risk posed to health and safety of surrounding individuals [32]. The Fig.8 demonstrates the proper way of wearing these PPE's [17]. The impacts caused by not proper disposal of PPEs are given in Table 3.

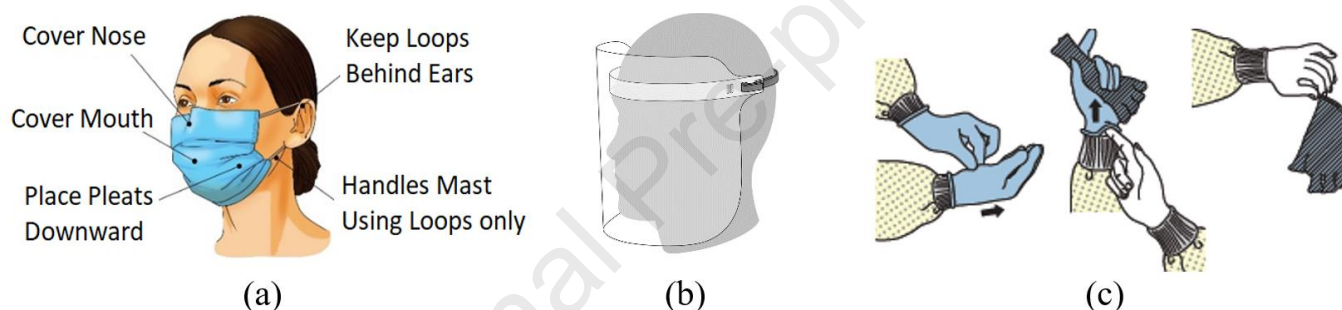


Fig 8: Practice of PPE's during COVID-19 Pandemic.

Table 3: Impacts of improper disposal of PPEs in Fiji during COVID-19 pandemic.

	Impact
Human	Improper disposal of PPEs gives additional work to municipal waste management staff. It also improves their health and safety as they get more vulnerable.
Environment	Land and water pollution. Due to decomposition and weathering, the plastic material gets washed into the ocean which affects under water ecological life.
Animal	PPE's lying on land tends to be a play with materials for dogs, birds, and cats. As a result they become carries of COVID-19 virus and in return affect humans.

4.0 Results and Observation

It was evident that the COVID-19 pandemic has increased pollutions which will pose a great threat and environmental challenge in coming years. In surveys conducted by the researchers, PPEs were found in coastal areas, near roads, bus stations, car parks, markets, towns, and cities, given in Fig. 9. This new variety of PPE pollution poses a challenge to top predators in the ocean, as well as providing a source of microplastics.



Fig. 9: Different PPEs pollution found in Fiji (personal collection).

The occurrence of PPE was surveyed during the COVID-19 pandemic, data collected from 23rd April still 11th June 2021. Figure 10a shows the area which is surveyed in Suva, Fiji. During the eight weeks of samplings, and eye-catching survey discovered a total of 44 items across sites. Face masks were the most frequent item found throughout the survey period, accounting for 27 of the total (61.36%), followed by 17 hand gloves (38.64%), as shown in Fig. 10c. Interestingly, no face shields were found on any site. Even though these monitoring durations may not be sufficient to conclude that PPE pollution is expanding over time, but it important to note that there will be a growth in the coming months as COVID-19 cases are increasing.

These values were used to calculate the PPE density in each sampling site as described by [33].

$$C = \frac{n}{a} \quad (1)$$

Where C is the density of PPE per m², n is the number of PPE counted, and a is the surveyed area.

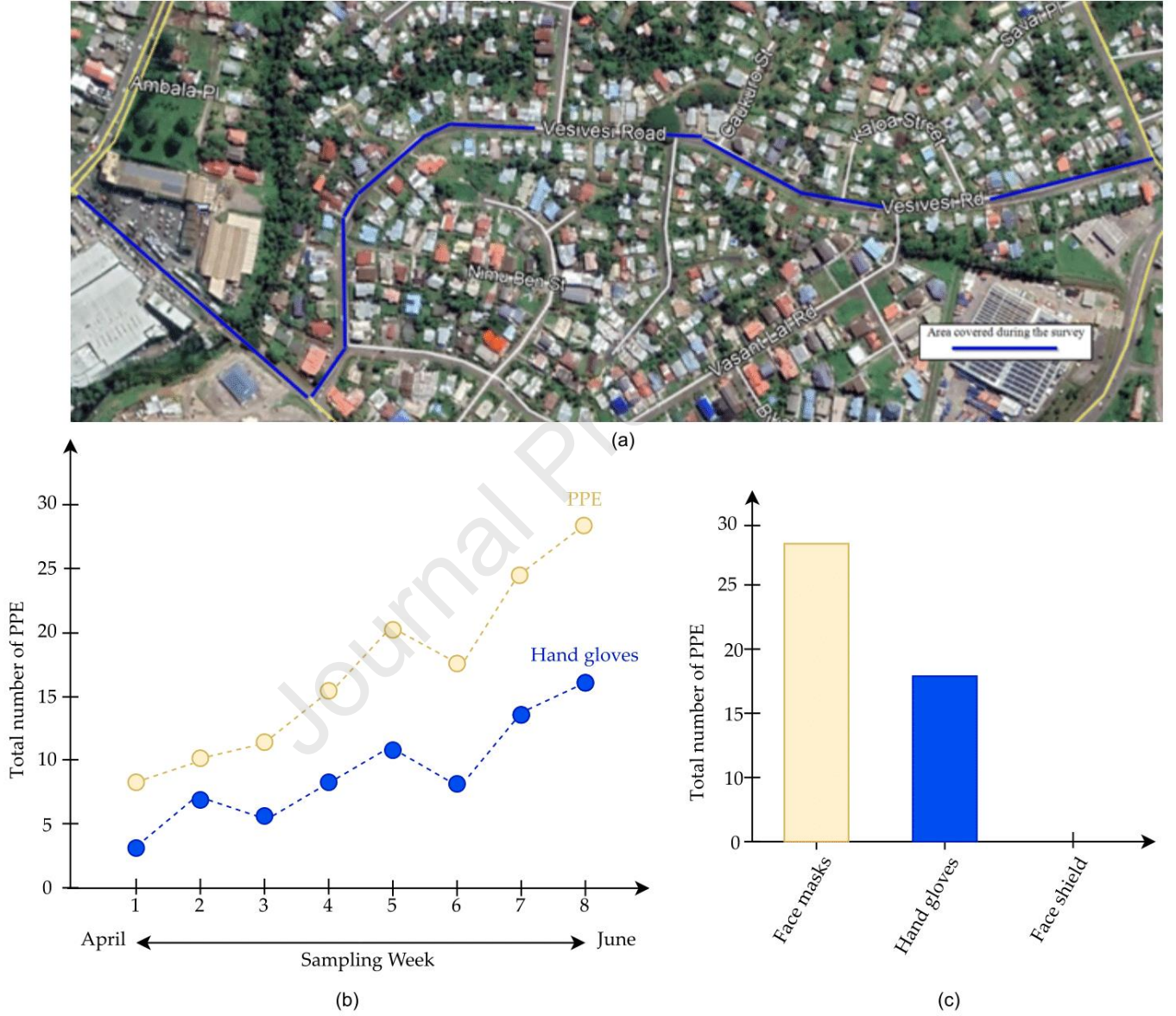


Fig. 10 (a) Map of the region and sampling site, (b) cumulative number of PPE across sampling site, and (c) total number of face mask and hand glove.

Notably, due to negligence of people, lack of environmental awareness, and poor municipal waste management practices have initiated this issue. Only a few articles report PPE pollution in coastal environments in Fiji islands. Hence, it is important to put effort into PPE pollution research to have a better understanding of the impact all across the environmental compartments.

5.0 Discussion

At first level, the COVID-19 pandemic seems to be implicitly leading to the UN 2030 SDGs (namely 6, 14, and 15 SDGs) by increasing the risk towards clean water sanitation, life below water, and life on land. It is a sad reality that the PPEs utilized in the due course of the COVID-19 pandemic are becoming a health and environmental concern. It is very important to advise and educate the general public on the impacts of inappropriate PPE disposal on the health and environment. It is suggested to address this unethical practice at an early stage before the problem starts replicating and becomes irreversible

5.1 SDGs vs. COVID-19 impact

One of the most significant SDG goals is to combat climate change; consequently, SDGs 6, 14, and 15 are studied in this research, as well as how COVID-19 has stopped toward achieving these goals. Based on these the impacts associated are given in Table 4.

Table 4: Impact and Drawback of PPEs pollution on SDGs

Goals	End life of PPEs	Drawback
SDG 6: Clean Water Sanitation	Used PPEs are not properly disposed and thrown near beaches, sea beds, near roads, bus stations, car parks, markets, towns, and cities	Normally it ends up in river, sea, and small creeks. Hence, it contaminates river and fresher water which may be used for washing and drinking purpose. Animals also use to river water for drinking, but presence of PPEs micro particles causes many issues. Colour of water also changes.
SDG 14: Life Below Water		Once PPEs enter in water it breaks down into micro-particles. These micro particles harm the marine life. It also makes the river or sea water dirty.
SDG 15: Life on Land		Used PPEs lying on ground causes environmental pollution. It is not appealing. It also can transmit the virus to the other person who does the cleaning or by

		mistake steps on it with open sores. Animals such as birds, cats, and dogs are normally attracted to wastage materials. They can also become sick if it is eaten by mistake (when mixed with other waste product).
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5.2. PESTLE Analysis of COVID-19 in Fiji

The COVID-19 pandemic can be further classified into six categories and each can be differently studied. It is important to comprehend the PESTLE analysis. The *Political, Economic, Social, Technological, Legal* and *Environmental* (PESTLE) are the popular pillars which are explained in below subsection. A graphical representation of PESTLE is given in Fig.11.

Political Concern: Government authorities' role is critical as they set laws and orders during this time. Health Ministries are obliged to provide proper health facilities. At this stage, controlling people's movement is a great concern as a lot of effort is taken to achieve less local movement. International relationship is also a concern, as assistance is provided in terms of vaccines, foods, and capital.

Economic Concern: The pandemic has tremendously impacted world gross domestic product (GDP), particularly for the developing island countries. Currently the hotcake discussion globally is inflation, economic stability, employment, and local & foreign investments.

Social Concern: The rapid transmission of COVID-19 virus has a great impact across countries in many ways including; lifestyles, business & social cultural structure, demographics, and people's lives and communities.

Technological Concern: During the lockdown, smart devices such as mobile communication, internet and bio-machines offered a big advantage. Globally the Internet of Things (IoT) smart devices and technological advances have promoted online education, work from home, and conducting virtual international meeting.

Legal Concern: Globally different legal issues have largely impacted countries due to their set of rules for social behaviour. Poor management of peoples' movement has been related to corporate governance, disclosure, contracts, financing, strategic transparency, employment and others.

Environmental Concern: Looking at current situation, this virus has taken lives of millions of innocent individuals in many countries across the world however on the flip side, nature has shown some of the positive responses due to lesser movement thus lesser pollution. But COVID-19 created a serious concern in regards to land and water pollution due to improper disposal of face mask and hand gloves. The drawback of PPE's pollution with impacted SDGs is summarized in Table 4.

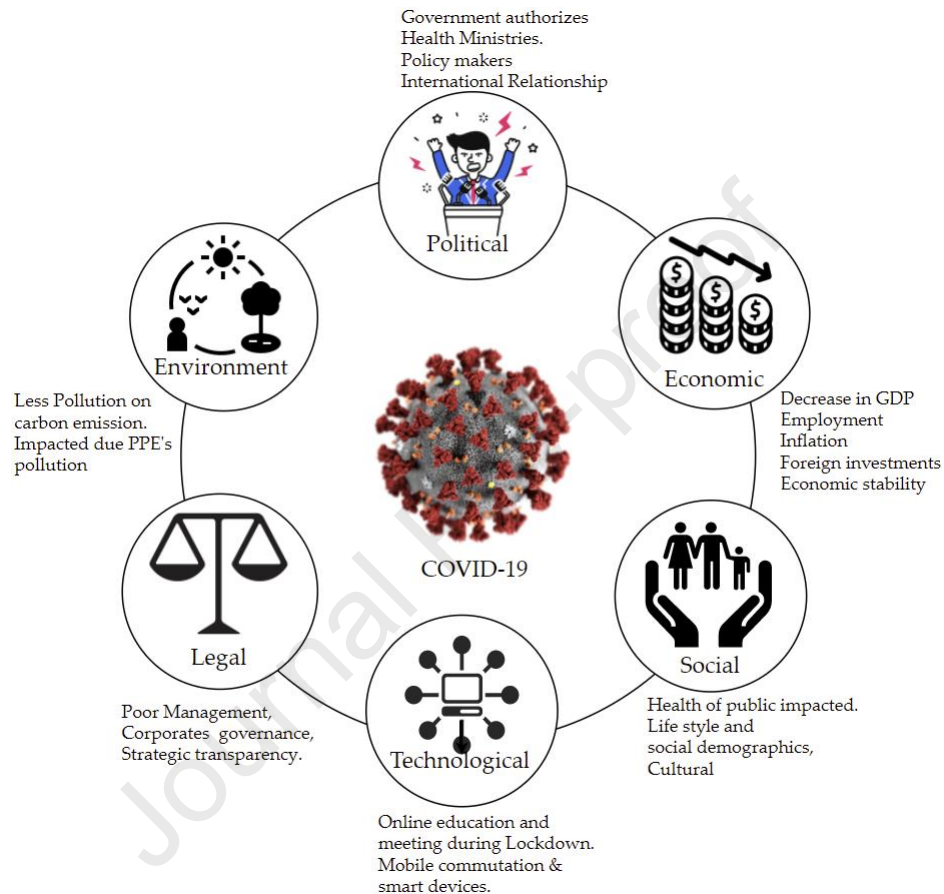


Fig. 11: Systematic representation of PESTLE for COVID-19.

5.3 Disposal Method

It is well known that improper PPEs disposal cause a lot of threats whether it is to human, animal, or on the environment. One of the significant processes involved and that needs to be followed during COVID-19 is disposal of PPEs correctly. Figure 12 shows some of the processes associated with the PPE disposal. If proper disposal is not done, it will create a lot of issues which will impact both animal and human beings. If it is not disposed properly, it impacts clean water sanitation, life below water, and Life on land. Table 5 gives generalized disposal steps for each of the common PPEs used in Fiji. It is important to take

note and follow each step in the right way so that the local transmission of COVID-19 virus is controlled. Having said that, wearing PPEs does not ensure 100% protection, but it can definitely reduce the transmission of this deadly virus.

In addition, encouraging the use of reusable face masks is an important strategy to reduce PPE pollution. Considering that one of the major sources of plastic pollution in Fiji is a lack of environmental awareness, long-term programs are needed to change citizens' attitudes and encourage sustainable practices that can help prevent future plastic pollution.

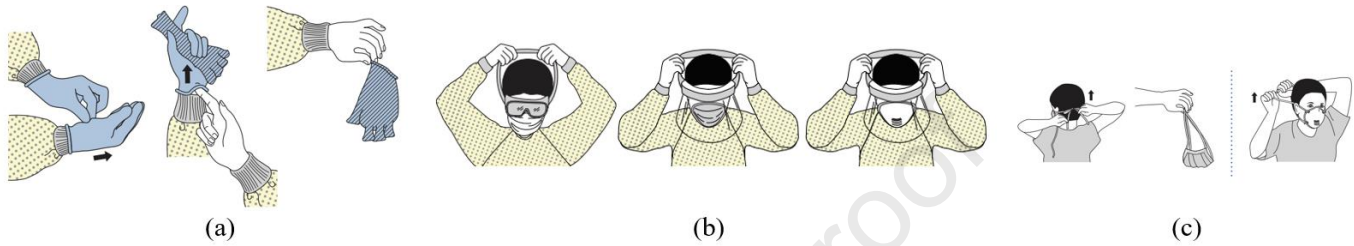


Fig. 12: Different types of PPE's disposal method.

Table 5: Disposal Steps of various PPEs

PPE Type	Disposal description	Figure
Hand gloves	As the gloves may be contaminated, it is advisable to remove the gloves using an appropriate procedure. The procedure is to remove one glove by grasping the palm area of the other and hold it in the gloved hand. Remove the other one by sliding fingers from the wrist end peeling it off and disposing it properly. If the hand is contaminated while removal, it is recommended to wash your hands or sanitize it.	Fig 11(a)
Face shield	The face shield may be contaminated so it is advisable to remove by unstrapping the head band or removing the ear bands. Dispose it properly. If the hand is contaminated while removal, it is recommended to wash your hands or sanitize it.	Fig 11(b)
Face masks & respirator	The mask may be contaminated therefore do not touch it. Remove the mask without touching the front but the ear straps around the ear. Dispose it correctly in a disposal container. If the hand is contaminated while removal, it is recommended to wash your hands or sanitize it.	Fig 11(c)

Largely, different governing authorities have put in place some effective waste management measures during the pandemic. For a sustainable waste disposal exercise during the COVID-19 pandemic Table 5 summarizes the procedures. While this outbreak differs from prior infections, it is possible that a novel treatment could make a significant difference and create a trend for other countries.

6.0 Conclusion

Like other countries, Fiji is also experiencing the impact of COVID-19 and it is critical to report its threatening impact in literature. In this research, the effect of high usage rate and incorrect disposal of PPEs during COVID-19 has shown a huge environmental impact. Globally, the outcomes are similar, improper PPE disposal practices are a major source of concern for human and environmental health. In Fiji, due to negligence and not good enough incineration facilities, used PPE from residential areas causes a threatening challenge for municipal waste management and is a leading carrier for aquatic ecosystem pollution. Hence, due to recurrent outbreaks of COVID-19, extensive use of PPE by the general public is critical to avoiding the pandemic's extreme negative environmental consequences. This research was conducted during the lockdown period and the following observations were made.

- Littering of facemask was more frequent compared to hand glove, 61.36% was accounting for face masks and followed by 38.64% for hand gloves. Mostly general public used face mask, hand gloves are used by medical practitioners, police officer, municipal waste management, and shopping malls workers in Fiji.
- There limited face shield litters as it is commonly used in shopping malls, hospitals and restaurant.

Due to the negligence caused by Fijian citizen, a huge amount of used PPE's are ending up in marine eco-system which is serious and alarming concern. It is important to prevent such activities by following the simple steps involved in PPE's disposals. A PESTLE analysis is discussed to weight the challenge which is given by COVID-19. Use of PPEs during this COVID-19 crisis is valid as the spread of the virus can be contained, however if the correct disposal of used PPEs are not practiced then the use of PPEs for such situation is illogical and irrational. The following recommendation will surely improve the negative impact of PPEs.

- Create awareness (educate) on the impact caused by PPE pollution,
- Warning on packaging,
- Standardize government waste policies,

- Polices to set on biodegradable masks,
- Put penalties if found littering,
- Use unmanned aerial vehicle (UAV) for monitoring of PPEs pollution,

Declaration of competing interest

No conflicts of interest.

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Reference

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Aneesh A. Chand – Concept development, study design; data collection, writing original draft, editing drafts, approval of final article.

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The Guarantor is the one or more people who accept full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. Please note that providing a guarantor is compulsory.

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